I CLAIM:

1. A method for processing materials, comprising:

passing materials to be processed in a flow path through an annular processing passage between two closely spaced smooth surfaces provided by respective inner and outer cylindrical apparatus members at least one rotating relative to the another; and

irradiating the materials in the processing passage with processing energy through a wall of one of the two members.

2. A method as claimed in claim 1, wherein the energy applied to the processing passage is any one of electromagnetic energy of microwave frequency, light, X-rays, gamma radiation and ultrasonic longitudinal vibrations.

3. A method as claimed in claim 1, wherein the cylindrical apparatus members rotate relative to one another about respective longitudinal axes that are coaxial with one another so that the radial spacing of the two surfaces is constant circumferentially thereof.

4. A method as claimed in claim 1, wherein the apparatus members are moved so as to produce a linear velocity between their operative surfaces relative to one another of at least 0.5 meter per second.

5. A method as claimed in claim 1, wherein one or both of the surfaces is coated with catalytic material that enhances at least one of chemical, bio-chemical and biocidal reactions in the processing passage.

6. A method as claimed in claim 1, wherein the cylindrical apparatus members rotate relative to one another about respective horizontally oriented parallel longitudinal axes.

7. A method as claimed in claim 1, wherein the cylindrical apparatus members rotate relative to one another about respective vertically oriented parallel longitudinal axes.

8. A method as claimed in claim 1, wherein the outer member remains substantially stationary while the inner member rotates to produce a linear velocity between their operative surfaces relative to one another.

9. A method as claimed in claim 8, wherein the processing energy irradiating the materials in the processing passage passes through the wall of the outer member.

10. A method as claimed in claim 8, wherein the processing energy irradiating the materials enters the processing passage through at least one window in the wall of the outer member.

11. A method as claimed in claim 10, wherein the processing energy is electromagnetic energy produced by at least one microwave tube connected to at least one port in the wall of the outer member leading to the at least one window in the wall of the outer member.

12. A method as claimed in claim 11, wherein the frequency of the electromagnetic energy is between 2.5 GHz and 50 GHz.

13. A method as claimed in claim 8, wherein the processing energy is light irradiation introduced into the annular processing passage through at least one laser light guide.

14. A method as claimed in claim 1, wherein the processing energy is produced by at least one transducer.

15. A method as claimed in claim 1, wherein the relative rotation produces eddies in the materials to be processed.

16. A method as claimed in claim 1, wherein the processing energy is electromagnetic energy and the height of the annular processing passage is less than the penetration depth of the electromagnetic energy into the materials to be processed.

17. A method as claimed in claim 16, wherein the frequency of the electromagnetic energy is between 2.5 GHz and 50 GHz and the electromagnetic energy enters the processing passage through at least one window in the wall of the outer member; and further including:

producing eddies in the materials to circulate the molecules of the materials to be processed past the at least one window to provide substantially even exposure on a molecular level of the materials to be processed.

18. A method as claimed in claim 15, wherein the material to be processed is substantially opaque to the processing energy and wherein the eddies circulate the materials to be processed past the processing energy to provide surface renewal so that the molecules of the materials to be processed are substantially evenly exposed to the processing energy.

19. A method as claimed in claim 1, wherein:

the materials to be processed include a gas and a liquid;

the height of the annular processing passage is small enough and the cylindrical apparatus members rotate relative to each other rapidly enough so that the

gas is emulsified into the liquid to produce a gas/liquid emulsification, thereby increasing the interfacial contact between the gas and liquid; and

the gas/liquid emulsification is irradiated with the processing energy through a wall of one of the two members to facilitate a reaction between the gas and liquid.

20. A method as claimed in claim 1, wherein:

the height of the annular processing passage is small enough, the cylindrical apparatus members rotate relative to each other rapidly enough and the two closely spaced smooth surfaces are smooth enough so that the materials to processed are essentially free of Taylor vortices; and further including

irradiating the materials to be processed with the processing energy through a wall of one of the two members to facilitate a reaction in the essentially Taylor vortices-free material.

21. An apparatus for processing material comprising:

two cylindrical apparatus members mounted for rotation relative to one another, and defining two closely spaced smooth surfaces providing an annular processing passage constituting a flow path for the material; and

an energy source for applying processing energy to the processing passage through a wall of the two members.

22. An apparatus as claimed in claim 21, wherein the energy applied to the processing passage is any one of electromagnetic energy of microwave frequency, light, X-rays, gamma radiation and ultrasonic longitudinal vibrations.

23. An apparatus as claimed in claim 21, wherein the cylindrical apparatus members are mounted to rotate relative to one another about respective longitudinal

axes that are coaxial with one another so that the radial spacing of the two surfaces is constant circumferentially thereof.

24. An Apparatus as claimed in claim 21, wherein the apparatus members are moved so as to produce a linear velocity between their operative surfaces relative to one another of at least 0.5 meter per second.

25. An apparatus as claimed in claim 21, wherein one or both of the surfaces is coated with catalytic material that enhances at least one of chemical, bio-chemical and biocidal reactions in the processing passage.

26. An apparatus as claimed in claim 21, wherein the cylindrical apparatus members rotate relative to one another about respective horizontally oriented parallel longitudinal axes.

27. An apparatus as claimed in claim 21, wherein the cylindrical apparatus members rotate relative to one another about respective vertically oriented parallel longitudinal axes.

28. An apparatus as claimed in claim 21, wherein the outer member remains substantially stationary while the inner member rotates to produce a linear velocity between their operative surfaces relative to one another.

29. An apparatus as claimed in claim 28, wherein the processing energy irradiating the materials in the processing passage passes through the wall of the outer member.

30. An apparatus as claimed in claim 28, further comprising at least one window in the wall of the outer member through which the processing energy enters the processing passage and irradiates the materials.

31. An apparatus as claimed in claim 30, wherein the processing energy is electromagnetic energy produced by at least one microwave tube connected to at least one port in the wall of the outer member leading to the at least one window in the wall of the outer member.

32. An apparatus as claimed in claim 31, wherein the frequency of the electromagnetic energy is between 2.5 GHz and 50 GHz.

33. An apparatus as claimed in claim 28, wherein the processing energy is light irradiation introduced into the annular processing passage through at least one laser light guide.

34. An apparatus as claimed in claim 21, further comprising at least one transducer for producing the processing energy.

35. An apparatus as claimed in claim 21, wherein the relative rotation produces eddies in the materials to be processed.

36. An apparatus as claimed in claim 21, wherein the processing energy is electromagnetic energy and the height of the annular processing passage is less than the penetration depth of the electromagnetic energy into the materials to be processed.

37. An apparatus as claimed in claim 36, wherein the frequency of the electromagnetic energy is between 2.5 GHz and 50 GHz;

and further comprising:

at least one window in the wall of the outer member through which the electromagnetic energy enters the processing passage; and

eddies produced in the materials for circulating the molecules of the materials to be processed past the at least one window to provide substantially even exposure on a molecular level of the materials to be processed.

38. An apparatus as claimed in claim 35, wherein the material to be processed is substantially opaque to the processing energy;

and further comprising:

eddies produced in the materials for circulating the materials to be processed past the processing energy to provide surface renewal so that the molecules of the materials to be processed are substantially evenly exposed to the processing energy.

39. An apparatus as claimed in claim 21, wherein:

the materials to be processed include a gas and a liquid;

the height of the annular processing passage is small enough and the cylindrical apparatus members rotate relative to each other rapidly enough so that the gas is emulsified into the liquid to produce a gas/liquid emulsification, thereby increasing the interfacial contact between the gas and liquid; and

the gas/liquid emulsification is irradiated with the processing energy through a wall of one of the two members to facilitate a reaction between the gas and liquid.

40. A method as claimed in claim 21, wherein:

the height of the annular processing passage is small enough, the cylindrical apparatus members rotate relative to each other rapidly enough and the two closely spaced smooth surfaces are smooth enough so that the materials to processed are essentially free of Taylor vortices; and

the materials to be processed are irradiated with the processing energy through a wall of one of the two members to facilitate a reaction in the essentially Taylor vortices-free material.

41. A means for electromagnetic processing of material comprising:

two cylindrical apparatus members mounted for rotation relative to one another, and defining two closely spaced smooth surfaces providing an annular processing passage constituting a flow path for the material; and

a means for supplying electromagnetic energy to the material through a wall of the two members.